ANALYSIS OF A STATE POLICE ACADEMY MENU CYCLE FOR DIETARY QUALITY AND PERFORMANCE NUTRITION ADEQUACY

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Title of Study: ANALYSIS OF A STATE POLICE ACADEMY MENU CYCLE FOR DIETARY QUALITY AND PERFORMANCE NUTRITION ADEQUACY

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Abstract:
Background: Law enforcement officers have high rates of overweight and obesity. With diet as a leading risk factor, early career nutrition interventions could be beneficial for establishing long-term healthy eating habits. Training academies present as an early career intervention opportunity. Thus, the purpose was to determine the diet quality (DQ) and performance nutrition adequacy of a state police academy's cafeteria menu. **Methods:** This cross-sectional content analysis included six weeks (three daily meals, Monday–Friday) of a state police academy menu. Nutrient content was determined by meeting with the dining facility manager, portioning menus, and gathering food specifications and then performing nutrient analysis. DQ was assessed using the Healthy Eating Index (HEI) 2015. Independent *t*-test and Cohen's *d* determined differences between menu nutrient content and performance nutrient needs. **Results:** The total HEI score was 54. Subcomponent scores indicating adequacy included daily protein (4.97 out of 5) and whole fruits (4.77 out of 5). Seafood and plant proteins (0.33 out of 5), ratio of fatty acids (1.31 out of 5), and dairy scores (1.59 out of 10) were low. Total fruit (3.19 out of 5), whole grains (6.10 out of 10), total vegetable (3.77 out of 5), and dark greens and legumes (3.51 out of 5) scores could be improved. The menu met recommended intake for 13 of 19 nutrients investigated. Nutrients that did not meet adequacy were calories (% mean difference, needs – menu = 36.7%), carbohydrates (% mean difference = 52.3%), vitamins D (% mean difference = 82.5%) and E (% mean difference = 66.7%), magnesium (% mean difference = 44.1%), and potassium (% mean difference = 41.8%). **Conclusions:** The academy menu leaves room for various improvements in DQ and shortfall nutrients. By focusing on increasing low subcategory scores, overall DQ of the menu will increase and could potentially make up for some inadequate nutrients.

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CHAPTER I

INTRODUCTION

Police officers are responsible for enforcing the law and maintaining public order via investigation and prevention of criminal activities. However, few measures have been taken to protect the health of these public servants. Research suggests that officers have a similar prevalence of overweight and obesity, when compared to the general population.[1,2] In the United States (US) alone, body mass index (BMI) assessments have placed approximately 38.7% of police officers in the obese (BMI>30) weight category.[3] BMI is subject to measurement error and has also been shown to underestimate weight status in values greater than 28.[4] Thus, the previously mentioned assessments could potentially be underreporting the amount of police officers suffering from obesity.

Obesity has been known to be linked to various chronic diseases, such as pulmonary diseases,[5] cardiovascular disease (CVD),[6] diabetes mellitus type two,[7] and different forms of cancer[8] in the general population. The research shows that this population is just as susceptible to the aforementioned chronic diseases as the general population.[1,9-11] In order to address obesity pandemic that is currently plaguing the nation, one must examine two of the most important contributors to weight status, nutrition status, and diet quality.

Diet quality (DQ) refers to a way of describing and gauging an individual's diet in terms of health. By analyzing an individual or population's DQ, researchers are able to better evaluate diet and dietary habits, analyze efficacy of nutrition interventions, and assess risk of chronic diseases.[12] The various factors that can influence DQ can be divided into demographic related factors (geographic location,[13] socioeconomic status,[14] ethnic background,[15] & age[16]) and non-demographic related factors (non-homeostatic variables,[17] communal eating,[18] social media,[19] & perception towards nutrition[20]). For measuring DQ, numerous indices have been developed based on adherence to scientific and/or government guidelines.[21] Scoring for the indices will typically assess moderation, balance, variety, and adequacy of specific food groups and nutrients.[22] Out of all the indices, the Healthy Eating Index (HEI) is consistently updated, as it assesses DQ in relation to the Dietary Guidelines for Americans which updates every 5 years, and has been shown to be both valid and reliable amongst the US population for people two years and older.[23] Positive DQ scores indicate good adherence to government or scientific guidelines for a healthy diet; good adherence has been shown to have favorable effects on weight status, while poor adherence will yield the opposite.[24]

As mentioned previously, LEOs have high rates of overweight and obesity. With diet as a leading risk factor for obesity, early career nutrition interventions could be beneficial for establishing long-term healthy eating habits. Training academies present as an early career intervention opportunity. By targeting LEOs early in their training phase, relevant staff members may be able to induce beneficial long-lasting dietary habits. Thus, our purpose was to determine the DQ and performance nutrition adequacy of a state police academy's cafeteria menu.

CHAPTER II

LITERATURE REVIEW

Dietary Quality

When describing one's diet, qualitative terms are commonplace. Words such as *balanced* or *nutritious* are not rare when used to describe a healthy diet, with healthy being synonymous with good. However, the liberal usage of such subjective language is a fallacy that clouds what a healthy diet should be. This begs the question, "how are professionals able to objectively determine if an individual's diet is healthy or not?". Dietary quality (DQ) is a term used to gauge how healthy an individual's diet and eating habits may be.[22] Its uses include evaluating an individual or population's dietary habits, determining the efficacy of nutritional interventions, and a possible risk assessment tool for diet-related chronic disease.[12] However, DQ is also victim to subjectivity and used as an umbrella term for concepts such as *healthy diet, balanced diet, nutritious diet, overall-healthy diet, etc*. Current DQ indices seek to combat this subjectivity by translating subjective data into more objective and quantitative measurements.[25]

Assessment tools of DQ typically consist of comparisons between individual eating patterns and recommended dietary guidelines.[21] These recommended dietary guidelines are often based on established government and scientific dietary

Recommendations and dietary indices. Most DQ indices will utilize a scoring system to determine if a diet has high or low DQ. Scoring systems typically assess how much moderation, balance, variety, and adequacy/volume is consumed in terms of specific food groups and individual nutrients.[22] Dietary quality indices are often adapted to suit specific demographic needs, such as age groups or geographic regions; this results in numerous ways of scoring DQ and assessing and individual's diet. Common DQ assessment tools include the Dietary Quality Index (DQI), Healthy Diet Indicator (HDI), Mediterranean Diet Score (MDS), and Healthy Eating Index (HEI).[22,25]

Healthy Eating Index. The original HEI was developed in 1995, looked at ten dietary components, and used a 100-point scoring system.[26] The HEI-2015 is currently the most recent iteration and analyzes compliance with the 2015-2020 Dietary Guidelines for Americans (DGA)[27] The current version consists of thirteen major food and nutrient groups split between two sections, adequate consumption (nine groups) and moderate consumption (four groups). Adequate consumption groups include total fruits, whole fruits, total vegetables, greens & beans, whole grains, dairy, total protein foods, seafood & plant proteins, and fatty acids. The moderate consumption group consists of refined grains, sodium, added sugars, and saturated fatty acids (SFA). Adequate consumption groups do not have a defined upper limit, whereas the moderate consumption groups do not have a defined lower limit. Each food group is weighed differently but will have a maximum point score of either five or ten.[27] For scoring, anything above 80 will indicate good DQ, while anything 50 and below will indicate poor DQ. Scores between 51 and 80 represent a middle group and indicate that DQ of the diet needs improvement.[28]

As evidenced by the numerous assessment tools for DQ and revisions for each index, there is no gold-standard measurement. The lack of consistent measurements leaves room for error and shows that DQ indices are not always perfect. However, while there are no perfect DQ indices**,** the HEI-2015 has been shown to be both reliable and valid in populations to whom the DGA are applicable, two years of age and older.[23] It has a history of being consistently updated with the USDA Guidelines for Americans and being validated upon update.

Factors Affecting DQ. The primary goal of DQ is to analyze an individual's diet and put it in objective and quantifiable measurements. Thus, any factor that affects one's diet will affect their DQ score. Much like diet, DQ is affected by a multitude of demographic factors, such as geographical location, ethnic background, and age. Non-demographic factors will include areas such as motivation, communal and social settings, social media influence, and dietary perceptions.

Demographic factors. An individual's diet is heavily influenced by their geographic location. Location is strongly tied to a region's cultural norms and food availability. For example, the Western diet has characteristics that include a high content of protein derived from processed meats, saturated fats, refined grains, corn-derived fructose syrup, and reduced amounts of fruits and vegetables.[13] This type of diet is commonly found in the US and a majority of Western Europe. When evaluated using the HEI, these characteristics of the Western diet lead to a lower DQ score. Concerning food availability, there is research that reveals gaps between federal dietary guidelines and the US food supply.[29] The research implies that the food actually available in the US is not compliant with what is recommended; this insinuates that in the US, people are more prone to a lower DQ due to food availability.

While high DQ foods may be physically available in stores, an individual's financial situation may prevent consumers from being able to purchase these goods. Price has been pronounced as a determinant factor in food choice and there is evidence that shows low-income families consume less fruits and vegetables than those with a high-income.[14] There is additional research that suggests that those with a low socioeconomic status have an unhealthier style of eating.[30] The research cites the disparity in energy costs between energy-dense and nutrient-dense foods as one causal mechanism; the easy accessibility for low-cost energy-dense foods is also a factor.

Another common demographic factor frequently examined is ethnic background. Amongst ethnic populations in the US, Hispanics have been shown to have a higher DQ in comparison to their African-American or Non-Hispanic White counterparts. Research cites that Hispanic culture places a high emphasis on fruit and legume consumption, thus raising their DQ scores on specific indices.[16] There is also evidence to suggest an individual's ethnic background plays a stronger role in children who are dependent on their mothers for meals.[31]

The lifespan stage of an individual also plays a role in affecting DQ. Children, adolescents, adults, and older adults will each have different nutrient quantity requirements, resulting in differing criteria for what would be called a healthy diet.[16] As a result, adjustment for age is one of the more common revisions in DQ indices. There is also research that demonstrates that dietary habits developed during the early childhood phase will carry into adulthood and possibly into the geriatric period.[32,33]

Non-Demographic Factors. In the 21st century, food has become more readily available than in the past. Appetite and motivation to eat are no longer fueled solely by the body's energy and nutrient needs; there are now non-homeostatic factors that can fuel this motivation.[17] Some examples include work schedule and early childhood development.[34] These non-homeostatic factors can override homeostatic signals and stimulate eating in sated states, or inhibit eating in states of hunger.[35] Those with an intensive work schedule may be inhibited from eating; in some cases, motivation to eat may be non-existent.[34] In early childhood development, frequent family meals has been linked to positive DQ, which can also carry over into adulthood.[36]

For children and adolescent populations, the presence of a parent or guardian figure will also play a critical factor in DQ indices. Current research suggests that there is a positive correlation between the diets of parents and children.[37-39] For both children and adults alike, there is evidence that demonstrates meals with family and significant others increases DQ scores.

Family meals are associated with increased consumption of fruits, vegetables, calcium-rich foods, fiber, and several micronutrients.[18] In the elderly population, communal participation has been shown to slow the progressive decline in DQ.[40] Unfortunately, communal eating is not a perfect setting; there is research that suggests individuals will match their food intake with that of their companions despite achieving satiety.[41] By increasing consumption, the individual risks lowering their DQ score. Herman et al. suggest that this desire to match food intakes stems from a desire to adhere to social norms, the reassurance of foods safe for consumption, and observations that food taste good.[42]

Another factor shown to affect DQ is the influence of social media. Various marketing schemes, media outlets, and advertisements will often affect food choice; usually, this leads individuals to develop new dietary habits and preferences that will affect their DQ.[19] A significant target of current advertising is the fast food industry. Fast foods refer to not only fast-food restaurants but also convenience items commonly found in gas stations and corner stores. Fast foods are also typically high-fat and carbohydrate-heavy products that will lower an individual's DQ.[43] In a 2008 report by the Federal Trade Commission to Congress, approximately $1.6 billion was spent in advertising food to children. Of this amount, $500 million was spent on carbonated beverages, $300 million on restaurant foods, and $250 million on snacks and frozen desserts, while only $11 million was spent on fruits and vegetables.[44] Carbonated beverages are often higher in added sugars, thus further lowering an individual's DQ scores. As previously mentioned, children play a key role in influencing their parental figure's diet; thus advertising focused on children may inadvertently affect the adult.

In addition to the factors mentioned above, there is evidence of a relationship between dietary perceptions and DQ. In the US, an analysis was conducted to find possible correlations between DQ and the perceived importance of taste, nutrition, cost, and convenience for food choice.[21] While taste was regarded as the most important factor when deciding on foods, those who valued nutrition as very important had a better HEI score.[20] Thus, perceptions about one's diet and nutrition also have an effect on DQ.

Importance and Application of DQ. As previously mentioned, DQ serves as a way to translate subjective and qualitative data into objective and quantifiable measures. By quantifying data, one can quickly run statistical analyses, allowing researchers to draw correlations between different factors.[45] Quantitative data allows for easier replication of experiments and identifying differences in replicated trials.[46]

Quantitative data also enables DQ to serve as an indicator for health assessment in both individuals and populations.[47] Positive DQ scores indicate adherence to United States Department of Agriculture (USDA)'s dietary guidelines, which has been shown to have favorable effects on weight status.[24] Data from the DQ indices can be compared with chronic disease biomarkers found in USDA dietary guidelines, turning DQ into a marker for risk assessment in individuals. High DQ scores have been associated with reduced risk for chronic diseases while low DQ scores will increase risk.[48] Chronic diseases associated with DQ include cardiovascular diseases (CVD), diabetes mellitus (DM) type two, and numerous types of cancer.[49] By using DQ indices, professionals are able to implement nutrition interventions more effectively. By evaluating DQ of a group, tailored community interventions can be developed to improve health and decrease chronic disease risk.

Law Enforcement Officers

The Uniform Crime Reports Program defined law enforcement officers (LEO) as *individuals who ordinarily carry a firearm and a badge, have full arrest powers, and are paid from governmental funds allocated specifically for sworn law enforcement representatives.*[50] This definition not only refers to patrol officers on the street, but also officers assigned to administration, investigation, and special teams. Per the 2018 US Census Bureau, 65.5% of LEOs are Caucasian, and 85.3% are male. The median age of male officers is approximately 39.6yrs, and 38.8yrs for females. However, ages can range anywhere between 18-75yrs.[51] While officers are known employees of national and local law enforcement agencies, they are also hired by colleges, universities, and professional schools. Duties of LEOs can range anywhere between deskwork to pursuing suspects on foot; these duties often vary due to geographical area and population density.[52]

LEOs as Tactical Athletes. High levels of strength, muscular power, anaerobic power, flexibility and aerobic endurance are often required to complete the critical job tasks of a LEO. For this reason, LEOs have been referred to as tactical athletes.[53] For LEOs, their essential job tasks exhibit similarities with those of professional athletes specializing in both strength and endurance.[54] Common examples of strength-based feats performed by officers include lifting objects greater than 150lbs, manually breaching a door, and physically subduing an individual. For endurance, officers may need to walk or run for more than 10 minutes or exert sustained effort on a combination of tasks for more than two hours. In order to prepare for these demands, LE cadets are physically conditioned upon arrival at their training facility; ideally, their training will focus on increasing the aforementioned traits required of LEOs and developing habits that will be sustained upon completion of academy training.[55]

Performance Nutrition Needs of LE Cadets. For peak performance, nutrient needs for athletes are dependent on the type of physical activity being performed.[54] For calculating caloric needs in athletes, one requires a resting metabolic rate (RMR) and then multiplying the RMR by an activity factor.[54] Mifflin-St. Jeor equation for RMR has been shown to more likely calculate true RMR in comparison to other indirect calorimeter equations; indirect calorimeter calculations methods are also less time consuming and more easily accessible than direct calorimeter methods.[56] The activity factor, by which RMR is then multiplied to determine total energy expenditure including that from physical activity, is strongly dependent on the individual, but in the case of “mixed” athletes, or athletes that specialize in a combination of both strength and endurance like LE cadets, this factor ranges from 1.5-1.7.[54]

Similar to caloric needs of athletes, macronutrient intake recommendations for athletes should be individualized and customized to the individual. Macronutrient intake can be estimated by determining the intensity of daily exercise for cadets and officers. The intensity can be calculated by determining the metabolic equivalent (MET) for each separate exercise and summing the daily total. Light intensity activities will have a MET value of <3.0, medium intensity will have a MET value between 3.0-5.99, and high intensity exercises will have a value >6.0. MET values for exercises can be determined through *The Compendium for Physical Activities*.[57] In the case of Special Weapons and Tactics (SWAT) officers, their most frequent tasks often have MET values between 3.5-6.0.[58] Hence, the training that LE cadets undergo would also be of moderate intensity in order to prepare them for possible future tasks. For moderate exercise for 60min/day, similar to what LE cadets perform in training academies, daily carbohydrate needs can be estimated to 5-7g/kg.[59] Carbohydrate intake should also be spread throughout the course of the day in order to promote carbohydrate availability for pre-exercise, post-exercise, and during exercise.[60] For daily protein intake, exercise lasting ≤1 hour necessitates approximately 1.6-1.7g of protein/kg.[54] In addition, there should be an emphasis placed on the timing of protein intake (post-exercise and during meals), in order to optimize the skeletal muscle adaptive response in an athlete.[54] For the final macronutrient, fat, the intake can range from 20-35% of one's total energy intake; this variability and lack of a universal recommendation is due to various factors, such as athlete types, training demands, and differences in muscle-fat utilization.[60] A major habit to avoid in terms of fat intake is the extreme restriction or overconsumption of fats. Restriction of fats has been shown to contribute to a decrease in diet quality, which in turn can potentially increase risk for chronic diseases. For extreme consumption of fats and reduced carbohydrate intake, current evidence suggesting this practice would be beneficial for health or performance is inconclusive and such habits should be avoided until research conclusively states otherwise.[54]

For micronutrient intake, research has been found to be inconclusive for a multitude of reasons; these reasons include contradictions amongst findings, a vast amount of outdated literature, and various research limitations. Due to the lack of research pertaining specifically to athletes, one should follow the USDA's 2015-2020 DGA for micronutrient dietary reference intakes (DRIs) as a general rule.[61] Supplementation of micronutrients should be used when a deficiency is observed, but care should be taken in order to prevent exceeding recommendations; excessive intake could lead to impairing performance and health.[54] Rather than supplementation, consumption of a wide variety of fruits and vegetables should be encouraged to ensure adequate amounts of vitamins and minerals are consumed.

Health Status and LEOs. LEOs are seen as tactical athletes, however this does not leave them immune to issues with overweight, obesity, and chronic disease. When it comes to chronic disease prevalence, LEOs have been shown to be susceptible to the same diseases that are prevalent in the general population, such as obesity, CVD, DM2, and cancer. Overall, research on the health status of LEOs is lacking and less available than for other tactical populations like firefighters and military personnel. Research that does exist shows that CVD morbidity has been observed to be more prevalent in LEOs than the general population, and that CVD mortality accounts for 22% of on-duty deaths of this population.[1,9,62] DM2 has not been examined in a LEO population in the USA. However, a study conducted in Japan displayed results showcasing a higher incidence of DM2 in LEOs than in clerical workers.[10] For cancer, Wirth et al. has shown that LEOs are often exposed to factors that increase risk for all cancers and cancer mortality; examples of such factors include alcohol and tobacco use, UV light exposure, lack of physical activity, and underlying obesity.[11]

In terms of weight status, research shows that obesity and overweight conditions are present in LEOs similar to the general US population.[1,2] Per Hartley et al., abdominal obesity is prevalent in 38.9% of male Buffalo LEOs and 17.7% in female officers; this number can increase by up to an additional 37% when under stressful conditions.[63] There is also anecdotal evidence that suggests increased risk of obesity in high-demand and low-control work environments, i.e. law enforcement.[64] A 2015 study's findings indicated that the average LEO received approximately 20% of their weekly meals from fast food.[65] As previously mentioned, fast foods will typically lower an individual's DQ. The prevalence of chronic disease, overweight, obesity, and evidence of possibly low DQ diets shows the need for nutrition intervention.

Training Academy Nutrition Opportunity

In the US, the common indicator for measuring overweight and obesity is BMI. The primary contributor to BMI and weight status is excessive caloric intake from an individual's diet.[66] Unfortunately, incidence of overweight and obesity in the US has increased to epidemic levels.[67] This has led to increased risk of various diet-related chronic diseases.[68] One population that has been evidenced to have increased incidence of overweight and obesity are LEOs.[2] In order to prevent the increased prevalence of obesity in this population, LEO training academies may provide us the opportunity for an early nutrition intervention towards cadets' diets.

To become a LEO, training academies have been established to ensure these officers are both skilled and proficient in their duties and knowledgeable in their responsibilities. Therefore, these academies provide an opportunity to intervene early in an officer's career and encourage healthy eating habits that support health and maintain high occupational performance; this can be done by targeting the mandatory meals and snacks provided by the academy and training staff. For this reason, this study aims to determine the nutrient content and DQ provided by a state LEO academy's menus and to compare these menus' nutrient content to the performance nutrition needs of the average LE cadet.

CHAPTER III

METHODOLOGY

Study Design and Sampling Method

The study was a cross-sectional content analysis that looked at the performance nutritional adequacy and dietary quality of a 6-week sample menu from a state police training academy. The menu included 30 days and consists of breakfast, lunch, and dinner provided to academy cadets Monday through Thursday; on Friday, only breakfast and lunch was provided. Saturday and Sunday were not included because the academy does not provide meals on weekends. The analyzed menus were provided by the academy's food service manager for July and August of 2020 and is an example of what cadets are fed at the academy for the first six weeks. During these first six weeks, police cadets have their meals pre-portioned for them by cafeteria staff members trained in serving specific portion sizes.

The menu provided to the researchers included a list of foods served without specified serving sizes and lacking some necessary details for accurate nutrient analysis (e.g., the flavor and fat content of milk). Thus, researchers acquired a detailed purchase order from the food service manager to assist with food item details. Researchers also worked with the food service manager to determine serving sizes such that they accurately reflected what cadets were served. While preparing the menu for analysis, all assumptions concerning specific food ingredients and self-service items were reviewed by the food service manager to ensure accuracy. Approval from the Institutional Review Board was not required because this study does not involve human subjects.

Dietary Quality Assessment

Once nutrient content was analyzed, dietary quality, or the healthfulness of the menus, was assessed using the Healthy Eating Index (HEI) 2015.[27] The HEI scores overall dietary quality on a 100-point scale, including 13 food group and nutrient scoring components as well as general healthy nutrition concepts of adequacy, moderation, variety, and balance. The HEI has been deemed a reliable and valid measure of dietary quality for anyone two years of age or older and to whom the Dietary Guidelines for Americans apply.[23] HEI scores were calculated through a Microsoft Excel spreadsheet that was developed by one of the investigators.[69]

Performance Nutritional Adequacy

Individual menu days, including breakfast, lunch, and dinner were entered into nutrient analysis software (ESHA Research, Food Processor, version 11.6.441, 2018, Salem, OR) to determine nutrient content. The menu's nutrient content was compared to the performance nutrition needs of the average academy cadet to determine adequacy of the menu in supporting daily physical performance. Macronutrient calculations and micronutrient were derived from the Academy of Nutrition and Dietetics (AND).[54] The AND also determined which micronutrients were relevant for performance needs and stated that micronutrient adequacy should be based off of the DGA's recommendations for the general populace. The vitamins examined were vitamins A, C, D, E, B1, B3, B6, and B12. The minerals examined were calcium, magnesium, phosphorus, potassium, selenium, sodium, and iron.

Annual cadet anthropometrics were provided by the academy's wellness and fitness coordinator. This data consisted of the average cadet's age, weight, height, and BMI for the years of 2016-2019. Recommendations are based off the needs of the average police cadet in 2018 because the other years' average cadet had BMIs that were borderline obese. Using a higher BMI population would have changed the purpose to focusing on weight loss so we used the BMI that was borderline normal. The average cadet was 30.6 years old, 177cm, 83.3kg, and had a BMI of 26.5.

Statistical Analyses

Descriptive statistics included mean, standard deviation, percentages for proportions, and 95% confidence intervals for all nutrients, HEI total score, and HEI component subscores. Independent *t*-test was used to determine performance nutrition adequacy of the academy menu via differences in nutrient content between the menu (overall 30-day mean) the performance macro- and micronutrient needs of the average cadet (as specified above). Cohen's d was used to determine effect size of significant differences. Level of significance was set at $p<0.05$. All statistical analyses were completed using SPSS statistical software (version 25, standards, IBM, Armonk, NY).

CHAPTER IV

RESULTS

HEI Scores

Table 1 shows descriptive statistics for dietary quality of the academy menu for thirty days. The mean daily total HEI score was 53.9, which indicates that the overall diet quality provided by the menu is in need of improvement (good: >80, needs improvement: 50-80, poor: <50).[28] In almost all categories, the range and standard deviation indicate that scores greatly varied on a daily basis. The HEI scoring components for which this large variation was not observed were whole fruit, total protein, and added sugar, indicating that these food groups are more consistently provided and that this nutrient is consistently not provided.

Figure 1 visually presents the overall HEI score for the menu, as well as the subcomponent scores. Based on percentage of max score achieved, areas in which the menu is scoring high include added sugar (100%), total protein (99.5%), and whole grains (95.4%), followed closely by total vegetables (75.4%) and dark greens (70.1%). Areas in greater need of improvement include seafood/plant proteins (6.67%), fatty acid ratio (13.1%), and dairy (15.94%). The remaining three categories of total fruit (63.8%, refined grains (53%) and whole grains (61%) also leave room for improvement.

Table 1. Descriptive statistics for dietary quality of the academy menu

HEI-2015 Scoring Components	Mean	Standard Deviation	Range
Total fruit	3.19	1.05	1.65 – 5.00
Whole fruit	4.77	0.45	3.30 – 5.00
Total vegetable	3.77	1.23	1.09 – 5.00
Dark green/ legumes	3.51	2.03	0.00 – 5.00
Whole grains	6.10	4.82	0.00 – 10.00
Dairy	1.59	2.05	0.00 – 8.09
Total protein	4.97	0.14	4.21 – 5.00
Seafood/plant protein	0.33	1.27	0.00 – 5.00
Fatty acid ratio (MUFA+PUFA/SFA)	1.31	1.52	0.00 – 4.90
Refined grain	5.33	4.50	0.00 – 10.00
Sodium	4.67	3.21	0.00 – 10.00
Added sugar	10.00	0.00	10.00 – 10.00
Saturated fat	4.37	3.03	0.00 – 10.00
Total score	53.9	9.55	35.04 – 68.3

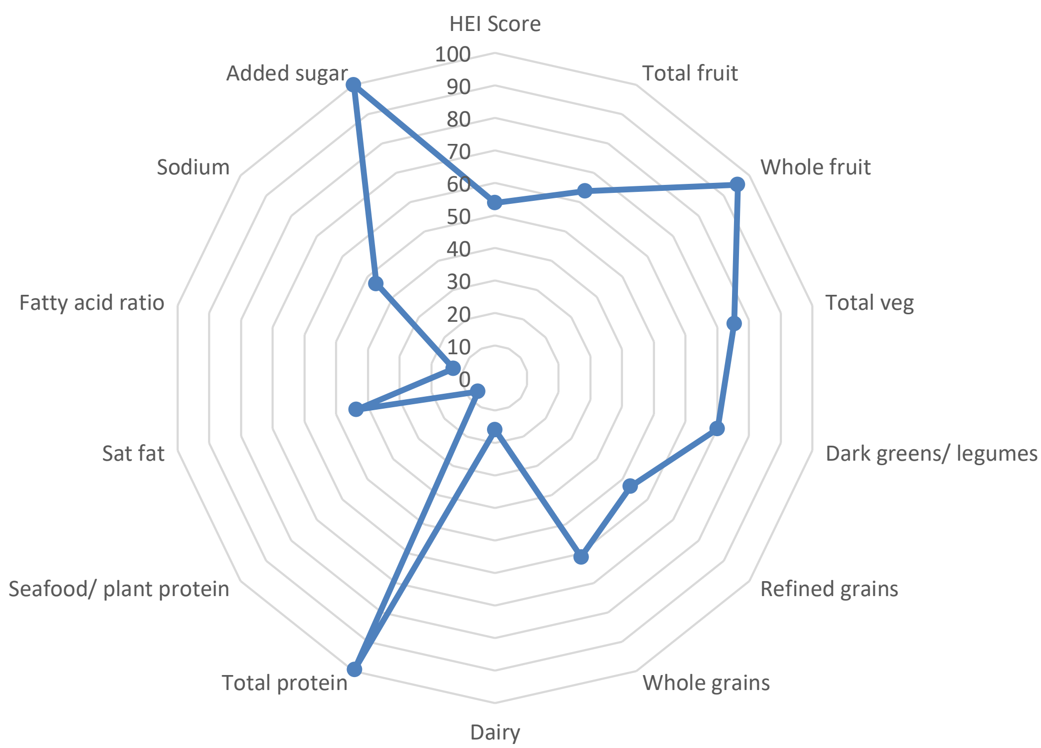

Figure 1. Percentage of max score achieved by the menu for the overall HEI score and all subcomponent scores (%)

Performance Nutrition Adequacy of the Academy Menu

Table 2 describes the nutrient content of the academy menu and compares it to the performance needs of the average cadet.[54] The findings indicate the menu is adequate in provision of protein, fat, vitamin A, B vitamins, vitamin C, calcium, iron, phosphorus, selenium, and magnesium (*p*s>0.05). The findings also indicate the menu alone is not meeting average cadet needs for calories (mean difference = 36.7%, $p<0.015$, partial eta squared = 0.19), carbohydrates (mean difference = 52.3%, $p<0.00$, partial eta squared = 0.36), vitamin D (mean difference =82.5%, $p<0.00$, partial eta squared = 0.98), vitamin E (mean difference = 66.7% , $p<0.00$, partial eta squared = 0.52), magnesium (mean difference = 44.1, $p<0.02$, partial eta squared = 0.16), and potassium (mean difference = 41.8, $p<0.04$, partial eta squared = 0.14). Despite the small effect size for differences in calories, magnesium, and potassium, the percent differences range from 36.7-44.1%, which is a clinically large difference. The difference per effect size was moderate for carbohydrates, however, this too was clinically significant with a percent difference of 52.3%. Finally, the effect sizes indicate a large difference in vitamin D and vitamin E between cadets needs and menu provision, which is supported by clinically large percent differences in provision.

Table 2. Comparison of nutrient content between the academy menu and performance needs of the average cadet

Nutrient	Average Cadet Performance Needs (mean)	Average Menu Yield (mean ± sd)	Mean Difference (needs – menu)	% Difference (mean diff / needs * 100)	*p*-value	Effect Size (partial eta squared)+
Calories (kcal)	2900	1834.98 ± 405.38	1065.02	36.7	0.015*	0.19
Carbohydrate (g)	415	197.95 ± 52.80	217.05	52.3	<0.001*	0.36
Protein (g)	130	101.05 ± 21.51	28.95	22.3	0.20	0.06
Fat (g)	80	72.73 ± 20.27	7.27	9.1	0.723	0.004
Vitamin A (mcg)	900	723.36 ± 450.28	176.64	19.6	0.70	0.005
Vitamin B1 (mg)	1.2	1.25 ± 0.41	-0.05	-4.2	0.91	0.00
Vitamin B3 (mg)	16	21.80 ± 9.43	-5.80	-36.3	0.55	0.012
Vitamin B6 (mg)	1.3	2.16 ± 0.89	-0.86	-66.2	0.35	0.03
Vitamin B12 (mcg)	2.4	3.13 ± 1.16	-0.73	-30.4	0.54	0.013
Vitamin C (mg)	90	99.77 ± 50.72	-9.77	-10.9	0.85	0.001
Vitamin D (mcg)	15	2.62 ± 0.32	12.38	82.5	<0.001*	0.98
Vitamin E (mg)	15	5.00 ± 1.76	10.00	66.7	<0.001*	0.518
Calcium (mg)	1000	590.66 ± 215.58	409.34	40.9	0.07	0.107
Iron (mg)	8	11.94 ± 2.85	-3.94	-49.3	0.19	0.06
Magnesium (mg)	400	223.52 ± 74.64	176.48	44.1	0.02*	0.157
Phosphorus (mg)	700	1332.98 ± 432.25	-632.98	-90.4	0.16	0.067
Potassium (mg)	4700	2733.64 ± 890.74	1966.36	41.8	0.04*	0.14
Selenium (mcg)	55	112.48 ± 40.05	-57.48	-104.5	0.17	0.064
Sodium (mg)	1500	3181.74 ± 1230.6	-1681.74	-112.1	0.19	0.059

*p-values <0.05 were considered significant

+effect size values <0.2 were considered small, 0.2-0.5 were considered medium, and >0.5 were considered large

CHAPTER V

DISCUSSION & CONCLUSION

Discussion

The purpose of this study was to determine the DQ of a state police academy's cafeteria menu and if the menu provided adequate nutrition for performance needs. The overall DQ of the menu, with a score of 54, is in need of improvement. The subcomponent scores indicate cadets are receiving adequate daily protein and whole fruits and low amounts of added sugars, while the overall menu lacks sources of seafood and plant proteins, unsaturated fats, and dairy products. Other subcomponents, related to vegetable, grain, and total fruit intake, could also be improved. Additionally, the menu met the recommended intake for thirteen nutrients out of the nineteen nutrients investigated. However, the six nutrients that did not meet adequacy are integral for performance needs; these six nutrients were calories, carbohydrates, vitamins D and E, magnesium, and potassium.[54]

For DQ, the subcategories that were in most need of improvement were seafood and plant proteins, unsaturated fats, and dairy. The lack of seafood and dairy may correlate with the large vitamin D deficiency. The ratio of poly- and monounsaturated fats to saturated fats indicates that there is a larger amount of saturated fats in the diet; this may lead to long-term cardiovascular diseases and other chronic comorbidities if this becomes a long-term dietary habit.[6] However, feasible solutions are available in order to increase these scores. The substitution of seafood, legumes, or tofu for land animal proteins throughout the week would greatly increase the points from seafood/plant proteins. Reducing cheese consumption and substituting oils for solid fats would also increase the points from fatty acids. For dairy, adding 8oz of milk every morning would also improve scores.

Furthermore, the HEI is meant to be reflective of the DGA; by having a high DQ score on the HEI, one would have a diet that consists of a better food group and nutrient composition. Thus, by improving the DQ score of the academy menu, we can assume that deficient micronutrients would improve. For instance, substituting seafood for some protein options in meals and increasing dairy provision would increase vitamin D intake. Carbohydrates, vitamin E, magnesium, and potassium would also increase with the addition of more vegetables and seafood and plant proteins. In order to increase calorie and carbohydrate intake, snacks should be, and in actuality are, provided between meals. It should be noted that snacks were not included in this assessment due to lack of information and significant variation between cadets.

Looking deeper into implications of the menu's nutrient content, a lack of calories and carbohydrates indicates that the cadets who are not receiving additional sources of nutrition (i.e., snacks provided by the program) may not be achieving peak performance due to undernutrition. The vitamins and minerals that were lacking are integral for performance in an athletic population. Vitamin D deficiencies in athletic populations have been associated with increased risk for morbidities, such as osteoporosis and osteomalacia.[70,71] Vitamin E serves as an antioxidant, which has been suggested to have beneficial effects on athletic populations by reducing muscle damage, fatigue, and improving performance.[72] Magnesium is a mineral that helps in maintaining normal muscle function, heart rhythm, blood glucose levels, and blood pressure; all of these traits are commonly studied to help aid athletic performance.[73] Lastly, potassium acts in conjunction with sodium in the Na^+/K^+- pump; this pump is integral for active transport of glucose or amino acids and regulating cellular volume. Additionally, it aids in skeletal, smooth, and cardiac muscle contractions.[54]

In relation to areas for future research and practice, researchers could determine the amount of snacks provided to cadets on average and include them in nutrient and DQ analyses. This process would require a detailed list of snack brands, portion sizes, and average times that the snacks were provided to each cadet. Additionally, this type of menu analysis could be performed with other academies to determine if these results are consistent across US LE academies. Finally, for practice, public health practitioners, particularly Registered Dietitians, could create suggested nutrition standards for menus, much like the National School Lunch Program. Practitioners could also offer this type of menu analysis as a service to help academies improve the healthfulness of their menus.

Strengths. A major strength of this study comes from the reporting of items listed on the menu. The dining facility manager provided product purchasing orders and recipes, which allowed the researchers to identify specific ingredients and brands used at the facility. Additionally, the dining facility manager proofread the detailed, portioned menu created by the researchers to ensure that portion sizes and food specifications were truly reflective of what cadets would be served. Additionally, the HEI was used to measure DQ, which has been shown to be both valid and reliable.[23] The methodology used for menu analysis has been utilized in previous studies[69,74] and undergone peer-review screening.

Limitations. There are several limitations to be noted in this assessment. A major limitation was the cafeteria menu was not necessarily indicative of what LE cadets actually consumed. Rather than measuring what was consumed, it measured what was served. Thus, if a cadet was not consuming enough food, the analysis was unable to account for it. Additionally, cadets consumed three pre-portioned meals on Monday through Thursday and for both breakfast and lunch on Friday. However, the menu did not account for meals on Saturday, Sunday, and anything consumed after lunch on Friday. Assuming the cadet eats three meals on Saturday and Sunday and another on Friday, the analysis lacked 1/3 of a cadet's meals for the week. Furthermore, the menu did not account for any additional snacks provided by the academy. As with all DQ indices, the HEI did not account for high limits for adequacy subcategories. For example, an individual that consumes 16oz of protein for every 1000kcal would receive full points in the protein subcategory, despite this being an extreme amount of protein.

An additional limitation is that there was a salad bar available for lunch and dinner, that was not included in the analysis. Thus, both vegetable subcategories and both fatty acid subcategories may not be truly reflective of the true value. The salad bar was not included in the analysis because there was a lack of data concerning portion sizes and types of vegetables consumed. Condiments for foods were also not included in the analysis for similar reasons. Subcategories that may be affected by this exclusion are added sugars, sodium, MUFA: PUFA ratio, and saturated fats.

Conclusion

Based on the score provided by the HEI, the menu provided by this particular academy leaves room for various improvements. While it does provide adequate nutrition for a majority of the performance-related nutrients, it lacks in several key nutrients that are necessary for peak performance. By focusing on increasing HEI subcomponent scores, overall DQ of the menu will increase and could potentially make up for the nutrients that are inadequate. Considering the high rates of obesity among LE populations and diet as a leading risk factor, academy menus present as an early career intervention opportunity through which to have a potential lasting impact on cadet health and performance. Providing feedback similar to that of this analysis could be invaluable.

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